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Claims

1. A mass spectrometry system comprising:

a microchip which has a channel through which a sample passes and a sample separation area being provided in said channel;

a light irradiation unit irradiating with a laser beam while moving a light irradiation position along said sample separation area; and

an analytical unit analyzing a fragment of said sample to obtain mass spectrometric data, said fragment of said sample being generated by a light irradiation.

2. The mass spectrometry system according to claim 1,

whrein said analytical unit includes a data memory unit, in which said light irradiation position and said mass spectrometric data corresponding to said light irradiation position are stored while associated with each other.

3. The mass spectrometry system according to claims 1 or 2,

wherein said sample separation area separates said sample according to a molecular weight, an isopotential point, or a surface hydrophobic property of said sample, and

said light irradiation unit irradiates with said laser beam while moving said light irradiation position along said sample separated in said sample separation area.

4. The mass spectrometry system according to any one of claims

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1 to 3,

wherein said channel is provided on a surface of a substrate, and said sample separation area has a plurality of columnar bodies.

5. The mass spectrometry system according to claim 4, wherein said sample separation area includes a plurality of columnar body arrangement portions in which said plurality of columnar bodies are arranged, and a path is provided between said adjacent columnar body arrangement portions, said sample passing through said path.

6. The mass spectrometry system according to claim 5, wherein a width of said path is larger than an average interval between said columnar bodies in said columnar body arrangement portion.

7. The mass spectrometry system according to claims 5 or 6, wherein said plurality of columnar body arrangement portions are combined and arranged such that a plane arrangement is to be a substantial rhombus, and said columnar bodies are arranged such that said plane arrangement of each of said columnar body arrangement portions is to be a substantial rhombus.

8. The mass spectrometry system according to claim 4, wherein the density of said plurality of columnar bodies is gradually decreased toward a proceeding direction of said sample in said channel.

9. The mass spectrometry system according to claim 4, wherein

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the density of said plurality of columnar bodies is gradually increased toward a proceeding direction of said sample in said channel.

10. The mass spectrometry system according to any one of claims 4 to 9, wherein said sample separation area and an adjustment area are alternately formed with respect to a proceeding direction of said sample in said channel, said columnar bodies being formed less densely in said adjustment area than in said sample separation area.

11. The mass spectrometry system according to any one of claims 4 to 10, whrerein a metal layer is provided on a surface of said columnar body.

12. The mass spectrometry system according to any one of claims 4 to 10, wherein said columnar body is made of metal.

13. The mass spectrometry system according to any one of claims 1 to 12, wherein said laser beam is an infrared laser beam or an ultraviolet laser beam.

14. The mass spectrometry system according to any one of claims 1 to 3, wherein said sample separation area has a plurality of concaves.

15. The mass spectrometry system according to claim 14, further comprising a projecting portion in said sample separation area, said

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plurality of concaves being provided in said projecting portion.

16. The mass spectrometry system according to claims 14 or 15, wherein said concave is formed by an anodic oxidation process.

17. The mass spectrometry system according to any one of claims 1 to 16, wherein a surface of an inner wall of said channel is hydrophilized.

18. The mass spectrometry system according to claim 17, wherein said inner wall of said channel is hydrophilized by a hydrophilic substance adhered to said surface of said inner wall of said channel.

19. The mass spectrometry system according to claim 17, wherein said inner wall of said channel is hydrophilized by forming a silicon thermal oxide film on a surface of said channel.

20. The mass spectrometry system according to any one of claims 1 to 16, wherein a surface of an inner wall of said channel is water repellent treated.

21. The mass spectrometry system according to any one of claims 1 to 3, wherein a surface of said sample separation area has a plurality of first areas and a second area, said first areas being arranged while separated from one another, said second area occupying said surface of said sample separation area except for said first areas, and one of said first area and said second area is a hydrophobic

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area and the other is a hydrophilic area.

22. The mass spectrometry system according to claim 21, comprises a plurality of said sample separation areas.

23. The mass spectrometry system according to claim 22, wherein said plurality of sample separation areas are arranged in a stripe shape.

24. The mass spectrometry system according to any one of claims 21 to 23, wherein said hydrophobic area is formed by a film containing a compound having a hydrophobic group.

25. The mass spectrometry system according to claim 24, wherein said compound having said hydrophobic group is a silane coupling agent having a hydrophobic group.

26. The mass spectrometry system according to claim 24, wherein said compound having said hydrophobic group is a silicone compound.

27. The mass spectrometry system according to any one of claims 21 to 24, wherein said hydrophobic area is formed by bringing a polydimethylsiloxane block into contact with a surface of said channel which is hydrophilic.

28. The mass spectrometry system according to any one of claims 21 to 24, whrerein said hydrophobic area is formed by printing a

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liquid silicone compound onto a surface of said channel which is hydrophilic.

29. The mass spectrometry system according to any one of claims 21 to 28, wherein said sample separation area is formed by providing a mask having an opening on at least a part of a surface of said channe, depositing a compound having a hydrophobic group via said opening on said surface of said channel, and removeing said mask, said hydrophobic area being arranged in said sample separation area.

30. The mass spectrometry system according to any one of claims 21 to 29, wherein said hydrophilic area is constituted of a film containing a compound having a hydrophilic group.

31. The mass spectrometry system according to claim 30, wherein said compound having said hydrophilic group is a silane coupling agent having a hydrophilic group.

32. The mass spectrometry system according to any one of claims 21 to 31, wherein said sample separation area is formed by providing a mask having an opening in at least a part of said surface of said channel, depositing a compound having a hydrophilic group via said opening on said surface of said channel, and removing said mask, said hydrophilic area being arranged in said sample separation area.

33. The mass spectrometry system according to any one of claims 1 to 32, whrerin said plurality of channels are provided and a liquid

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sample introducing channel intersecting said channels is provided.

34. The mass spectrometry system according to claim 33, wherein said plurality of columnar bodies are arranged between said sample separation area and a part where said channel and said liquid sample introducing channel intersect each other.

35. The mass spectrometry system according to any one of claims 1 to 34, further comprising a damming portion in which columnar bodies are arranged in a line.

36. The mass spectrometry system according to claim 35, wherein said damming portion is arranged adjacent to said sample separation area.

37. The mass spectrometry system according to any one of claims 1 to 36, wherein said sample separation area is divided into a plurality of areas through a slit.

38. The mass spectrometry system according to any one of claims 1 to 37, further comprising an external force applying unit applying external force to said sample to move said sample in said channel.

39. The mass spectrometry system according to claim 38, wherein said external force is electric force.

40. The mass spectrometry system according to claim 38, wherein

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said external force is pressure.

41. The mass spectrometry system according to any one of claims 1 to 37, wherein a micro channel is formed in said sample separation area, and said sample is introduced from said channel to said sample separation area through said micro channel by capillary phenomenon.

42. The mass spectrometry system according to any one of claims 1 to 41, wherein an upper portion of said channel is coated with a thin film including a matrix for mass spectrometry.

43. A mass spectrometry system comprising:

a substrate;

a sample separation area in which sample adsorption particles adhere to said substrate to develop a sample according to a specific property;

a light irradiation unit irradiating with a laser beam while moving a light irradiation position along said sample separation area; and

an analytical unit analyzing a fragment of said sample to obtain mass spectrometric data, a fragment of said sample being generated by a light irradiation.

44. The mass spectrometry system according to claim 43, wherein said sample adsorption particles are silica gels.

45. The mass spectrometry system according to claims 43 or 44,

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wherein said analytical unit includes a data memory unit, in which said light irradiation position and said mass spectrometric data corresponding to said light irradiation position are stored while associated with each other.

46. A method of analysis in which a mass spectrometric analysis is performed with the use of a microchip having a sample separation area, comprising:

a step of separating a sample in said sample separation area according to a specific property of said sample;

a step of irradiating with a laser beam while moving a light irradiation position along said sample separation area; and

a step of analyzing a fragment of said sample to obtain mass spectrometric data, said fragment of said sample being generated by a light irradiation.

47. The method according to claim 46, further comprising:

a step of obtaining a first mass spectrometric data, said step of obtaining said first mass spectrometric data including a step of depolymerizing said sample after said step of separating a sample;

a step of analyzing a fragment of said sample to obtain a second mass spectrometric data by performing said step of irradiating with a laser beam without performing said step of depolymerizing said sample after said step of separating a sample, said fragment of said sample being generated by a light irradiation; and

a step of identifying said sample based on said first mass spectrometric data and said second mass spectrometric data.

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48. The method according to claims 46 or 47, further comprising a step of immobilizing said separated sample to said sample separation area prior to said step of irradiating with a laser beam after said step of separating a sample.

49. The method according to any one of claims 46 to 48, further comprising a step of spraying a matrix for mass spectrometry onto said sample separation area prior to step of irradiating with a laser beam after said step of separating a sample.

50. A method of analysis in which a mass spectrometric analysis is performed with the use of a microchip having a sample separation area, comprising:

a step of developing a sample in said sample separation area according to a specific property of said sample;

a step of irradiating with a laser beam while moving a light irradiation position along said sample separation area; and

a step of analyzing a fragment of said sample to obtain mass spectrometric data, said fragment of said sample being generated by a light irradiation.

51. The method according to claim 50, further comprising:

a step of obtaining a first mass spectrometric data, said step of obtaining first mass spectrometric data including a step of depolymerizing said sample after said step of developing a sample;

a step of analyzing a fragment of said sample to obtain a second

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mass spectrometric data by performing said step of irradiating with a laser beam without performing said step of depolymerizing said sample after said step of developing a sample, said fragment of said sample being generated by a light irradiation; and

a step of identifying said sample based on said first mass spectrometric data and said second mass spectrometric data.

52. An analytical method according to claims 50 or 51, further comprising a step of immobilizing said developed sample to said sample separation area prior to said step of irradiating with a laser beam after said step of developing a sample.

53. An analytical method according to any one of claims 50 to 52, further comprising a step of spraying a matrix for mass spectrometry onto said sample separation area prior to said step of irradiating with a laser beam after said step of developing a sample.